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MINERAL RESOURCES

OF

NORTH CAROLINA.

BY

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Read before the Franklin Institute at the monthly meetings of Nov. and Dec., 1871.

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ON THE MINERAL RESOURCES OF NORTH CAROLINA.

BY

F. A. GENTH.

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[From the Journal of the Franklin Institute.]

For a long time past the State of North Carolina has been noted for its great and varied mineral wealth, hence it became the favored field for speculations of every sort, some of these of the wildest character. It is not, therefore, to be wondered at that failure should have met most of those schemes, which contemplated mere stock operations in place of a legitimate development of the mines. However, as an unfortunate consequence of those speculative undertakings, an impression has been cast in our northern cities to the effect that the mineral riches of that state were more imaginary than real. The fallacy and injustice of such a conclusion were fully demonstrated to me twenty years ago, during a residence of nearly two years in the State, and since that time my faith in the mining resources of North Carolina has been strengthened by frequent visits as an expert, during which I have examined most of the gold, silver, copper, lead, zinc and iron mines of the central counties. In addition to those many opportunities of acquiring positive evidence of the mineral wealth of that State, it was my good fortune to spend a great part of last summer in North Carolina in company with Prof. W. C. Kerr, the very able State Geologist, at whose request I visited the principal mineral localities of the State for the purpose of working up the mineralogy for the geological report. My field for examination has been quite extensive, embracing, more or less, about thirty-two Counties of the State.

As one of the results of the geological survey of North Carolina, it may be interesting here to state that it has already contributed to the development of several mining localities, which have invited the attention of northern capitalists; other mining properties are in process of negotiation, and I have no doubt that, when better known, many other mines, which at present are neglected, will command the attention they justly deserve, offering, as they do, inducements for safe and profitable investment.

Although my labors in North Carolina in connection with the geological survey were generally directed to the mineralogy of the State, I have nevertheless made numerous observations, and acquired many facts which may be interesting to the members of the Franklin Institute. I intend giving a brief account of the vast mineral resources of North Carolina, but ere I describe the occurrence of the different ores, it may not be amiss to sketch, in a concise way, the general outline of the geology of that State, without, however, entering into a geological discussion with reference to the position and age of the various rocks, but simply confining myself to their petro-graphical determinations.

Almost the whole State of North Carolina is made up of gneissoid or granitic rocks, alternating with strata of argillites, quartzites and talcose, chloritic and micaceous slates, all more recent rocks, resulting from the destruction of the older.

These are overlaid, in its eastern and south-eastern portion, for a distance of from ninety to one hundred miles from the coast by tertiary and cretaceous deposits, with numerous marl beds, of much local importance for the agricultural development of this portion of the State. Many of these beds contain small quantities of lignite and pyrite, but not in sufficient quantities to be of any commercial value.

The older formations are arranged in nearly parallel bands or belts, which cross the State in a north-east to south-western direction. The tertiary and cretaceons formation rests immediately upon a belt of quartzites and slates bearing N. 25—30° E. with a southeasterly dip, and these are underlaid by granite and gneissoid strata, which border them on the west and form the most eastern granite belt, known as the Raleigh belt, which occupies the greater portions of Warren, Franklin and Wake Counties, with Raleigh as a centre; and extends from there southwestwardly through Richmond County into South Carolina. It consists, to a large extent, of a granular granite, composed principally of orthoclase, greyish white granular quartz, and very little mica, which is frequently biotite. In many places the granite is a real granulite; in others it graduates into gneiss, and, here and there, into hornblendic strata.

The Raleigh belt is overlaid by very extensive beds of slates, argillite, quartzite, etc., with a north-west dip, traversing Granville, Person, Orange, Alamance, Randolph, Moore, Montgomery, Stanley, Anson, Union and the south-east part of Davidson, Cabarrus and Rowan Counties.

To the west of these slates, which have been called *taconic* slates by Emmons, another band of the oldest rocks is again observed. It has been called the Greensboro' and Salisbury granite belt, and occupies the principal portion of Caswell, Rockingham, Guilford, Forsythe, Davie, Davidson, Rowan, Iredell, Cabarrus, Mecklenburg and the eastern portion of Gaston, Lincoln and Catawba Counties. The granites are often granulites, consisting only of orthoclase and quartz. In many places they became porphyritic, by the dissemination of large orthoclase crystals throughout the mass; again they change to gneiss and micaschist, and frequently, through a gradual admixture of hornblende, they turn to syenite, hornblendic gneiss, hornblende-slates and even diorite. These hornblendic rocks are interlaminated with the granite and gneiss, and their gradual passage from one into the other are evidence of their cotemporary origin. As these hornblendic or dioritic rocks are less readily decomposed, they often form vein-like walls through the other rocks, so-called "trap dykes," and as the result of their partial disintegration, the surface is covered with rounded boulders.

Accumulations of various iron ores, hematites and magnetites, form bands in this belt of gneissoid rocks.

Another band of more recent slates, characterized by several important beds of limestone and magnetic iron, passes from King's Mountain in a northeasterly direction through Gaston, Lincoln and Catawba Counties; here it is interrupted, but it occurs again in Davie, Forsythe, Yadkin and Stokes Counties.

Proceeding in a westerly direction, we again come into the region of the oldest gneissoid and related rocks, very similar to those of the more eastern belts. These make up the bulk of the counties of Wilkes, Caldwell, Alexander, Catawba, Cleveland, Burke, McDowell, Rutherford, Polk and Henderson.

A narrow band of slates borders this granite formation through Surry, Wilkes and the north-western corners of Caldwell, Burke.

McDowell, Henderson, and passes through Transylvania County into South Carolina. These slates appear to be connected with those of Stokes county. In this band of slates in several localities there occurs a peculiar quartzite, which, by a minute admixture of mica between the rounded particles of quartz, forms the so-called "flexible sandstone" or itacolumite. The principal localities in which it has been observed are Linville in Burke, Bending Rock Mountain in Wilkes, and Sauratown Mountains in Stokes Counties. In this narrow belt of slates, several valuable limestones and iron ore beds have been discovered.

The last belt of gneissoid or granitic rocks occurs west of these slates. It is largely made up of gneiss and hornblende slates, with a frequent admixture of garnets and crystals of cyanite. These rocks occur in Alleghany, Ashe and Watauga Counties; they are interrupted, however, in the southern portion of the latter and the northern part of Mitchell county by a narrow strip of slates, which extends into Tennessee; but they then continue through Mitchell, Yancey, the greater portion of Madison, Buncombe, Haywood, Jackson, Macon and Clay Counties, and the southeastern part of Cherokee County. In this belt large veins of granite occur, with massive accumulation of orthoclase and muscovite, associated with garnet, tourmaline, beryl, etc.; also lenticular masses of magnesian rocks with chrome ores, either chloritic slates, etc., or granular chrysolite, which is the parent rock, by the alteration of which, in Pennsylvania, for instance, the serpentines have been produced. The extreme north western limits of the Counties of Mitchell, Madison, Haywood, Jackson, Macon and the greater portion of Cherokee, are again occupied by slates, frequently inclosing beds of marble and granular dolomite interlaminated with beautiful talcslates or micaceous slates, containing large crystals of staurolite, garnet, etc.

I have yet to mention as a very important formation the "triassic," which occupies a portion of the central counties of North Carolina. Resting upon Emmon's so-called taconic slates, narrow bands of shales and sandstones pass through Granville, the eastern edge of Orange and the western of Wake County, which in Chatham and Moore Counties widen and contain several valuable beds of coal; the formation continues through the south-east edge of Montgomery, thence through Anson County into South Carolina. The dip of these strata is south-east, and they form the south-eastern portion of the triassic formation, the central portion of which has been removed by erosion, whilst the north-west portion, with a north-westerly dip and resting directly upon gneissoid and granitic rocks, appears again in Rockingham and Stokes Counties, where it shows sandstones, shales and numerous outcrops of coal beds.

The gneissoid or granitic strata, as well as the slate formation, are frequently intersected by metallic deposits, either in veins and associated with quartz as a vein rock, or in ore beds, interlaminated with the strata, and forming a portion of the formation.

I will now proceed to the consideration of the occurrence of the different metals and other valuable minerals :

Gold. According to the earliest records the first piece of gold found in North Carolina was picked up in 1799, in a little branch at the Reid plantation, Cabarrus County. It weighed between three and four lbs., and was kept several years without its real character being suspected ; subsequently it was sold to a jeweller in Fayetteville for $3.50. When its true character became known, search was made for more, and fourteen lumps, weighing in the aggregate 153 lbs. troy, were obtained at the same locality.

The gold veins and gravel deposits were afterwards discovered ; and for a considerable time gold operations were conducted in many localities on a comparatively large scale. The discoveries of gold in California, where a far richer harvest was promised, led to the abandonment of many of those enterprises ; other causes have also influenced in the same direction, as, for example, the difficulties connected with deep vein mining, and the impossibility of extracting the gold by the imperfect and slow machinery then principally in use, the Chilean Mill and Arastra, etc., from heavy ores like pyrite, &c., which nature has not already decomposed. With the exception of minute quantities of telluride, in the *very rare* mineral nagyagite, at the King's mountain mine, gold in North Carolina is always found in the metallic state. It is rarely quite pure, but generally alloyed with more or less silver. It occurs in crystals or crystalline masses, in thin plates or laminæ, between the foliation of the slates or through associated minerals, such as quartz, pyrite, galenite, zinc-blende, etc., in such a fine state of division that it is generally invisible to the eye.

It has been observed in four different geological positions :

1st. It is met with in the *mass* of the gneissoid, granitic and hornblendic rocks.

2d. In quartz veins, often associated with pyrite, chalcopyrite, alenite, tetradymite and other minerals.

3d. In ore beds, cotemporary with the strata of rocks in which they are found, as in chloritic and talcose slates, argillites, quartzites, etc.

4th. Loosely in the soil and decomposed rocks, especially in gravel deposits, resulting from the destruction of the above first three formations. One of the most remarkable features peculiar to the rocks of the Southern States is their rapid disintegration.

The débris from these rocks forming the soil or ferruginous clay, remains in situ. This disintegration is frequently observed to a depth of over one hundred feet. Many of the railroad cuts show beautiful sections, and the study of these exhibits some highly interesting features, which I shall mention, as they are of the greatest importance to a full comprehension of the subject.

In many places cuts may be seen which appear to have been made in a uniform mass of clay, which, in general, is ferruginous; on close observation, however, it is easy to recognize that the *apparently* uniform clay stratum belongs to two distinct formations.

Immediately below the soil, which may be covered by vegetation, the ferruginous clay will be seen to contain, here and there, small fragments of quartz in angular pieces, with the edges more or less rubbed off, disconnected and not occurring in regular seams or veins; the number of those quartz pebbles gradually increases at a greater depth, until they form a regular stratum of gravel.

Some of those gravel beds are hardly perceptible; others vary from a few inches to over thirty feet in thickness.

When the great denudation took place, these fragments of quartz deposited themselves upon the *then* unaltered bed rock—the granite, gneiss, micaschist, slate, etc.; but after this period the disintegration of the rock continued, and it is natural that the same kind of clay should have resulted from the same parent rock.

Therefore we find, just below this gravel bed, ferruginous clay as above, but a closer investigation shows a great difference and especially two striking facts: in the first place the stratification can be observed and followed to the underlying, undecomposed rocks, and secondly, the quartz, which is found in the same, occurs not in loose angular pieces, but in regular seams or veins, in their original position.

In some of the auriferous regions of North Carolina, such quartz veins are very numerous; in others, they are less frequently met with.

Most of them are exceedingly small, varying in width from the thickness of a knife's blade to a few inches, and often extending in depth but a few feet; some bulge out and form nests or pockets in the rocks, while others again are of enormous size, and are known to exist as deep as they have been developed, which, in a few rare instances, is down to 200—300 feet.

Many of these quartz veins are in reality beds, as they coincide in strike and dip with the stratification, whilst an equally great number run in every conceivable direction, and dip just as irregularly.

The greater portion of these quartz veins contain *no* gold, or only such a small quantity that they could not be profitably worked, especially the large veins of vitreous and milky quartz.

Many of the small veins, principally those which contain granular or saccharoidal quartz, are rich in gold.

Some of the large veins, especially those containing much cellular quartz, have frequently been found to be the most productive. This cellular quartz results from the decomposition of pyrite, which once occupied the now empty spaces; leaving them either occasionally quite free from iron, or more generally rusty and more or less filled with limonite. These, the so-called brown gold ores, are the best and most easily worked. At a greater depth of the veins, where the pyrite is not decomposed, the gold is so much mixed with heavy sulphurous ores that, with the present system of operations, it cannot be extracted with profit; in many cases the gold disappears entirely.

Most of these gold veins in North Carolina were abandoned, when the iron and copper pyrites increased too largely, and before they had been wrought deep enough to contain copper ores in paying quantities.

The gold in these mines is not evenly distributed through the mass of the gangue; the veins often contain entirely barren portions alternating with rich ones, the latter called shoots of ore or chimneys.

Such shoots are in reality veins inside of a vein, and are frequently quite regular in their dip; the ores at the foot wall are generally richer than those at the hanging wall.

Many gold mines of this description have formerly been worked, and many of them undoubtedly are still of great value.

In Guilford County there were the McCulloh and Fisher Hill mines; in Cabarrus County, the Phœnix, Vanderburgh, Cullen, Pioneer Mills mines; in Mecklenburg County, the Capps, McGinn, Rudesill mines; and numerous others. At present, almost every one of them are unworked; some explorations are carried on in Cabarrus

County, and in Mecklenburg County the McGinn and the Wilson mines are the only ones in operation, and that on a small scale only.

At the McGinn mine they have a 5-stamp battery and amalgamated copper plates, also roasting ovens to decompose the sulphides; at the Wilson mine there is a 10-stamp battery with amalgamated copper plates, all after California patterns.

Many of the quartz veins in the slates, differing in strike and dip from the inclosing slate, carry gold, especially those which contain cellular and cavernous quartz, associated with limonite, hematite, siderite, pyrite, chalcopyrite, etc.

Some of them are highly promising, as, for instance, those of the Conrad Hill mine, in Davidson County; but, unfortunately, not a single vein has been sufficiently developed in depth to form a just appreciation of its value.

The gold deposits, which are cotemporary with the slates themselves, are of far greater importance than the true gold veins.

The talcose, chloritic, micaceous or arenaceous slates in which they occur, contain portions which are more or less charged with gold. The gold in these slate beds, like the slates themselves, is derived from the destruction of the older rocks, and has been deposited simultaneously.

The width of these auriferous beds varies from a few inches to from 60 to 70 feet.

The gold in them is often found without any admixture, and the auriferous strata shows no line of demarcation, and cannot be distinguished from the barren layers; but, generally, and subsequently to its deposition, it has been acted upon by chemical agencies, dissolved and precipitated again, and has assumed a crystalline structure; it has accumulated in strings which sometimes form lenticular and more highly auriferous masses in the beds, and is associated with crystalline quartz, pyrite, chalcopyrite, galenite, blende, mispickel, etc.

These are often parallel with the slates, and so close together that they can be worked by the same operation, especially where the slates between are also auriferous.

The Steele mine, in Montgomery County, and the Stewart mine, in Union County, are examples of this occurrence.

These gold mines have proved to be the only reliable ones in depth, and, if they are found to be rich enough for working, they can be depended upon for the future.

To this class belong the mines at Gold Hill, in Rowan County, which have already produced not less than $2,000,000, and have reached a depth of 750 feet. Although this appears to be a very large production, I do not hesitate to say that perhaps four-fifths of all the gold in the ore, which is a talco-micaceous or chloritic slate, intermixed with pyrite, magnetite, and a little quartz, has been lost in the tailings, on account of the very imperfect process used for the extraction of the same.

The King's Mountain mine, of Gaston County, also belongs to this class. The gold is, to a great extent, contained in a quartzose limestone, and is associated with very small quantities of pyrite, galenite, chalcopyrite, but also with the very rare tellurides of lead, altaite, and with nagyagite, a telluride of gold and lead.

In some places this ore bed is over thirty feet in thickness, and has been worked to a depth of 200 feet, but longitudinally only to a very small extent, not over 250 feet.

This mine is also said to have produced over $1,000,000. The machinery used for the reduction of the ores are a 20-stamp battery with amalgamated copper plates, etc.

There are at present no other mines belonging to this class in operation, but there is no doubt that Montgomery, Union, Stanley, Rowan, Davidson, Randolph, Gaston and Cherokee Counties have many localities, where profitable and successful mining operations might be carried on.

In gold mining operations, the deposits which result from the disintegration of the rocks, and subsequent denudation, are undoubtedly of the greatest importance; there the gold which was contained in the rocks and in the small auriferous veins (which have been broken up into fragments) has been concentrated by nature, and in many places has been deposited, with the remnants of the veins, in the gravel beds, which I have already mentioned.

Those gravel beds occur to a greater or less extent throughout the whole gold region; the oldest gneissoid rocks as well as the slate formation contain them.

The quartz in general is not water-worn, only the sharp edges are rounded. Many pieces still present the shape and thickness of the veins whence they came.

The most extensive gravel deposits exist in the South Mountains, on the headwaters of the first and second Broad River, Muddy Creek and Silver Creek, in the Counties of Rutherford, McDowell, Burke, Caldwell, also in Polk, and Cleveland; embracing an area of over 200 square miles.

They appear to cover the greater part of the land, rise often to a considerable height on the slope of the hills, but are naturally more concentrated in the bottoms and flat lands. The gravel beds in this region vary in thickness from a few inches to thirty feet, and are covered with soil and clay, which is also more or less auriferous, although much poorer than the gravel beds below.

These deposits have been worked since about 1830, and before gold was known in California many thousands of hands were at work digging and washing in a rude way, yet many millions of dollars were produced without the help of any complicated machinery, and without the knowledge of a proper use of water.

Since that time very little has been done; in some instances the old gravel was worked over again, and has made fair returns to the adventurers.

Very large tracts of land, containing extensive and valuable deposits, have never been touched, and, by the introduction of the Californian hydraulic system of operations, a safe and very profitable business could be carried on.

The gold is rarely found in nuggets; generally as fine dust and in small grains. Its fineness averages about 825 thousands. It is associated with numerous interesting minerals, such as platinum, diamond, zircon, xenotime, monazite, and many others.

Experiments with vein-mining in this region have not proved successful; the rich veins are too narrow in width, and of too limited extent in depth, and the large veins do not contain enough gold to be advantageously worked.

A small region of valuable gravel beds exists in the gneissoid rock and micaceous slate of Franklin and Nash Counties, in the eastern part of the State. It has been most extensively prospected at the Portis mine, where it is very rich, and has been worked since about 50 years, having produced, it is said, over $1,000,000.

The productive gravel is here the result of the disintegration of numerous small granular or sugary quartz veins, and very fine specimens of gold in such quartz are frequently met with.

The fineness of the Portis mine gold was generally about 985 thousands.

There are enormous gravel piles at the mine—the remnants of former operations.

Some very important but expensive experiments have been made at this mine.

Machinery was here erected for crushing and amalgamating the gravel, which, being part of gold veins, was thought could be profitably worked for gold.

The result was precisely what my own examination of the place convinced me it should have been—*a failure;* because, whilst the gravel may contain some very rich specimens, the whole bulk is too poor to be worked with profit. This is accounted for from the fact, which I have already intimated, that the gold in the gravel deposits. principally, is the *loose* gold, which had existed in the rocks and between their laminæ, or that from the *small* quartz veins, whilst the large veins are mostly *barren.* In a region which contains many small veins, the gravel deposits are generally valuable, even if the bulk of the beds has been made up from the destruction of large ones.

There are several highly important gravel deposits in Montgomery County, in the slate formation, some of which have produced a large amount of gold; the gold is mostly crystalline, in flat pieces, often covered with octahedral crystals, and in large nuggets; very little fine-grained gold has been found.

The best known deposit, which has produced large returns, but which is still, so to say, barely touched, is the so-called Christian mine.

The Swift Creek mine, about seven miles distant, produces gold of similar appearance.

West of the Blue Ridge several gravel deposits have been worked, to a greater or lesser extent, in Cherokee and Jackson Counties, also at Howard's Creek, in Watauga, and on the French Broad and New Rivers.

Throughout the whole gold region, every stream, branch and rivulet contains gold; and, as the washing of these is the most convenient way to obtain the precious metal on a small scale, there is hardly one which is not more or less worked, many of them up to their source.

Platinum. Only a few grains have been found in North Carolina, associated with gold in Rutherford and Burke Counties; and there is no prospect that it ever will be found in large quantities.

Silver, Lead, Zinc. I shall consider those three metals under one head, as they are always associated.

Silver is a rare metal in North Carolina. With the exception of the silver alloyed with gold, varying from 1 or 2 to about 20 per ct., in the gold from veins and gravel deposits of the granitic and gneissoid rocks, very little silver has been found in the veins of these strata.

The only localities which came under my notice were at the Baker mine, in Caldwell, and at Scott's Hill, in Burke County. There it occurs but rarely, in veins of auriferous quartz. At the latter place it is only observed after burning the ore, and a little fragment which I have seen makes me feel confident that it is present as cerargyrite, or chloride of silver.

Small quantities of argentiferous galenite and pyromorphite are associated with it.

Native silver has been observed with chalcocite or copper glauce at Gap Creek mine, in Wilkes County, and at the Asbury vein in Gaston County.

The only real silver mines of North Carolina are ore beds of zinc blende, mixed with galenite, in the argillaceous and talcose slates. The type of these is the old Washington mine, now Silver Hill, in Davidson County, which was discovered in 1838. Near the surface it formed a bed of carbonate of lead, having in many places films and plates of metallic silver disseminated through the mass of the ore. These ores were easily reduced, and produced handsome returns to the owners. This was, however, but of short duration. The undecomposed ores, which were a very fine-grained mixture of brown zincblende and argentiferous galenite, were soon reached, and presented great difficulties in the extraction of the precious metals.

When I was at the mine, about 22 years ago, an analysis of an average sample of between 2000 — 3000 tons of ore gave me about 45 per ct. of zinc, 21 per ct. of lead, about 8 ounces of silver per ton, with minute quantities of copper and gold. If the Philadelphia owners had abided by my advice, viz., to work the ores for zinc, and extract silver, copper and lead from the residues, they would probably still be in possession of this valuable mine.

The ore bed is large, and in one place has had a thickness of about 60 feet.

Occasionally it contains very rich spots, with native silver in lumps and filiform masses, or disseminated through the ore with argentite or highly argentiferous galenite; and besides these minerals this mine has furnished the most magnificent cabinet specimens of cerussite, pyromorphite, etc.

The mine is now 650 feet deep, and the ore is greatly mixed with slate. The purer masses are kept separate; the slaty ore is crushed and separated by buddles, etc., and the buddled ore is roasted and shipped to New York for the manufacture of the so-called Bartletts' white lead. The production of this mine is now about 400 — 500 tons per month.

Very similar ore is found about six miles north-east of Silver Hill. The vein has not been developed, and the work done at Silver Valley has not been productive.

The Hoover mine, about six miles from Silver Hill, contains galenite, in a more coarsely crystalline variety, in a calcareous veinstone, and the Boss mine, two miles distant, has furnished handsome cabinet specimens of galenite in quartz.

The McMakin mine, about 1½ mile south-east from Gold Hill, is a very interesting one; the principal vein is a large vein of zinc-blende in talcose and argillaceous slates; it contains native silver, argentite, argentiferous galenite, and highly argentiferous tetrahedrite. The latter contains, according to my analysis, 10·53 per ct. of silver, and an average sample of ore of a 5′ vein, at 80 feet depth, which was sent to me about 11 years ago, yielded 246 ounces of silver per ton, worth about $334. The mine is not worked, but looks favorable enough to deserve fresh attention.

The Troutman mine, also in the neighborhood of Gold Hill, and one mile south-east of it, has been opened as a gold mine. It consisted of porous quartz, and yielded near the surface very rich ores, worth $50 per bushel; at the depth of 100 feet, where the sulphides are undecomposed, the ores yielded only $1, and contained a string of ash grey zinc-blende with pyrite, from 2 to 6 inches in width, which had increased to 18 inches when abandoned at a depth of 160 feet. These ores are well worthy of a fuller investigation, as they may be rich in gold.

I have already mentioned, when speaking of gold, the beds and veins of gold ore in Union and Montgomery Counties, as being frequently associated with zinc-blende. The string veins of the Steele mine principally consist of these and galenite.

At the Long (or Monroe) mine, in Union County, the quartz veins in the slates are richly charged with argentiferous galenite; but the veins have not been sufficiently explored to know whether it will increase in depth.

At the Lemmond (Marion) mine, a very remarkable vein or bed has been worked; it is irregular in size, sometimes widening out from a few inches to six feet. It consists of quartz, richly charged with brown zinc-blende and galenite, with small quantities of arsenopyrite, chalcopyrite, often intermixed with grains of electrum, a highly argentiferous variety of gold. Both the galenite and the zinc-blende are very rich. I have examined a *pure* specimen of galenite which did not show any admixture of *free* gold to the eye, but which yielded at the rate of nearly 30 oz. of gold and 86½ oz. of silver to the ton; and pure brown zinc-blende gave me about 32 oz. of silver and gold, nearly half of which was gold. This vein appears to have a considerable longitudinal extension, and passes into the Steward mine property, formerly owned in this city.

At the latter mine, and at various other localities in this region, similar ores have been found, but the war has stopped all operations, and it will require capital and skill to develop this highly important mining district.

Galenite and zinc blende occur at several other mines, associated with gold ores, as at the Kings mountain, the Cansler and Shuford, and the Long Creek mines in Gaston county, etc. At Cedar Cove, McDowell county, in the limestones of the so-called taconic slates, at the Dobson mine, there is found an accumulation of yellow and yellowish brown zinc-blende mixed with lime. I have not, however, seen anything from there which looks encouraging.

Galenite and zinc-blende is associated with the gold ores at Murphy, Cherokee county. Highly argentiferous galenite occurs at several localities on Beech mountain, Watauga; argentiferous and auriferous galenite have been discovered at Flint Knob in Wilkes County, and I have seen specimens of it from Marshall, Madison County, Clayton, Johnson County, and Elkin Creek, Surry County, and also in several of the copper mines throughout the State, but I have no knowledge of any deposit of sufficient magnitude to be worked advantageously.

Tin.—No tin ore has been found in North Carolina as yet. Traces of this metal have been found in the tungstates of Cabarrus County, and in a micaceous slate in Gaston County, associated with garnet and columnar topaz (pycnite).

Copper.—Copper ores have been found in many localities throughout the State, in the veins of the old gneissoid rocks, as well as in the more recent slates, and even in the triassic formation.

The principal ore is chalcopyrite or copper pyrites; and there is every reason to believe that many of the mines require only a fuller development to enable them to furnish large quantities of valuable ores.

I have already mentioned that many of the gold veins are associated with pyritic ores, and in fact almost all the North Carolina copper mines in the central Counties have first been worked for gold, and there are hardly any mines in Guilford, Cabarrus and Mecklenburg Counties occurring in the gneissoid and syenitic rocks, which do not show strong indications of copper ores.

When mining operations receive a new impetus, it is to be hoped that this very important fact will be borne in mind, and that no mine should be started without sufficient means to develop it at once to such a depth that a workable body of copper ores may be reached.

The general character of these mines is that about at water level, the so-called brown gold ores are replaced by quartz richly charged with iron pyrites more or less mixed with copper pyrites, the latter increasing as the mine deepens, and in many places becoming the only, or the predominating ore, and forming a regular copper vein.

The ores either became poor in gold or the latter could not be extracted by the ordinary process, then chiefly in use in North Carolina—Chilean mills and arastra—therefore many valuable mines were abandoned, mostly before a larger and paying quantity of copper ores had been reached.

In this formation there is not at present a single copper mine in operation, although many look favorable for further development.

The principal mines which promised to change into copper mines are: in Guilford County, the Fisher Hill, the North Carolina, the McCulloh, Lindsay, Gardner Hill, Twin Mines, etc.; in Cabarrus County, the Ludowick, Boger, Hill, Phœnix, Orchard, Vanderburg, Pioneer Mills, etc., and in Mecklenburg the McGinn, Hopewell, Rudesill, Cathay Mines, etc.

The cupreous minerals observed in these mines are, near the surface, small quantities of native copper and cuprite, the latter sometimes in beautiful needles, the so-called chalcotrichite, malachite, rarely azurite, chrysocolla and pseudo-malachite, and in some of the mines chalcocite and barnhardtite; all resulting from the decomposition of chalcopyrite or copper pyrites, which forms the principal ore. Siderite or carbonate of iron often forms an important gangue rock.

A very important copper region extends through many of the western counties of North Carolina, which is best developed in Jackson, Watauga, Ashe, Wilkes and Alleghany Counties. The ores occur in hornblendic slates and gneissoid rocks.

In Jackson County, at the Savannah, the Cullowhee, the Wolf Creek Mines and others, large quantities of chalcopyrite or yellow copper pyrites have been obtained; at Elk Knob, in Ashe County, the ore consists of chalcopyrite with pyrrhotite, in a gangue rock consisting of a dark colored micaceous quartzite. The Ore Knob in the same County has furnished chalcocite or copper glauce.

At Gap Creek Mine, in Wilkes County, the ore consists of quartz with bornite or variegated copper ore and chalcopyrite. The ore sometimes contains silver and gold.

The Peach Bottom Mine in Alleghany County has been worked to a depth of 150 feet, and has produced a considerable quantity of ore; galenite occurs in a portion of the vein.

This whole mining region is well worthy the attention of capitalists, and when better facilities for transportation are offered, I have no doubt that it will be more fully and profitably developed.

The only two copper mines in North Carolina, which are worked at present to a limited extent, are in the so-called taconic slates.

The Clegg Mine in Chatham County is a large quartz vein in argillaceous slates. It is developed to a depth of 200 feet and has furnished large bunches of valuable ore. The ore is chiefly chalcopyrite, but other cuprose minerals have been found, among which azurite in small but beautiful crystals. The mine is in excellent order, and the machinery is of the best quality and very efficient. I understand that arrangements have been made to smelt the ores on the spot. Copper ores under similar circumstances are found at other places in Chatham, also in Person County.

The other mine is the so-called Emmons or Davidson copper mine, about six miles from Lexington. It has also been opened as a gold mine, but the ore was poor, containing not over thirty-seven cents per bushel, with a large admixture of iron and copper pyrites, occurring in a dark bluish green chloritic slate. It has been abandoned therefore as a gold mine and is worked only for copper. I learned a few days ago that works for the extraction of the ore by the humid way are in contemplation.

Almost identical in appearance, but richer in gold, is the so-called Barnhardt vein of Gold Hill. In the neighborhood of Gold Hill are several localities which have yielded rich copper ores; especially the Union copper mine in Cabarrus, about one mile from Gold Hill; it was worked more than any other in the neighborhood, and has furnished crystallized copper and cuprite, and a mixture of chalcocite and chalcopyrite and other ores.

Other mines in the neighborhood of Gold Hill, also several in Randolph and Davidson Counties, contain more or less copper; for instance, the Conrad Hill, show strong indications of copper.

Arsenic, Antimony and Bismuth.—Only a few ores of arsenic and antimony have been noticed in North Carolina. Amongst these is very rare native antimony, of which a small piece was submitted to my examination by Dr. Hunter, of Cottage Home, Lincoln County. It has been found in a small vein in Burke County. An examination proved it to be quite pure.

Both arsenic and antimony are found in combination with other metals: arsenic at a few localities in Union and Gaston Counties, in small quantities, as arsenopyrite or mispickel, associated with gold ores; and both arsenic and antimony in the highly argentiferous tetrahedrite of the McMakin, and the tetrahedrite of the Ludowick mines in Cabarrus County.

Bismuth has been observed as bismuthinite in minute particles associated with the gold and copper ores of the Barnhardt vein at Gold Hill, and by Dr. Asbury as bismuthite with gold ores at the Asbury mine in Gaston County; also as bismite, or teroxide of bismuth, in the same mine, and in combination with copper, lead and sulphur at Col. White's mine in Cabarrus County, probably as aikinite. The most interesting ores are the telluride of bismuth (tetradymite) and the tellurate of bismuth (montanite)—both found associated with gold ores in numerous localities—in Davidson, Cabarrus, Gaston, McDowell and Burke Counties. The bismuthic gold mentioned by Shepard as coming from Rutherford, is probably an artificial product resulting from the simultaneous amalgamation of gold and tetradymite.

Cobalt and Nickel.—Small quantities of these two metals have been observed in the manganese gossans of several mines in Gaston County, but thus far no regular workable deposit has been found.

Manganese.—The regular manganese deposits are as yet known in North Carolina; small quantities of pyrolusite, psilomelane and wad have been observed associated with iron, gold and silver ores, in several localities in the State. Many of the iron ores contain a small per centage of manganese.

The *manganese garnet* may become of considerable importance in the iron industry; it occurs in several large veins or beds. At Buckhorn it is associated with the magnetic iron, and serves as a valuable flux, it is also found near Danbury in Stokes county, in Rowan and Rutherford counties.

Chrome.—Minute quantities are found in the magnetic iron belt passing through Guilford and Rockingham Counties. Deposits of considerable magnitude exist in the chrysolite beds of Jackson, Mitchell, Yancey and Watauga Counties.

None of them are worked at present.

Iron.—Although the mineral wealth of North Carolina is affirmed beyond a doubt by its numerous mines and deposits of gold, copper, silver and other metals, still its greatest resources consist in its vast iron ore beds, distributed throughout the entire State; and when these are properly developed; their importance will by far exceed any other mining interest.

It may be safely predicted that, at an early day, North Carolina will stand foremost as an *iron*-producing State; not only because the various varieties of iron ore exist in inexhaustible quantities, but also because they are of very superior quality, and offer all those requisites to making the better and more desirable grades of *iron* and *steel.*

The principal ores are: the pure magnetic iron, the titaniferous and chromiferous magnetic iron, menaccanite or titaniferous iron, hematite or specular iron, limonite or brown hematite, and carbonate of iron. These ores, especially the magnetites and hematites, being in reality only a more ferriferous portion of the stratification form strings of large lenticular beds in the rocks, here and there interrupted but extending for many miles, and in some instances stretching across the entire State.

The outcrops of those ore beds being so very numerous, I cannot do more than indicate the various ranges and the localities where the ores are best developed.

But as there are also many places from which I have seen very fine ores, which require fuller investigation as to quantities, I will mention the locality, in the hope that this may lead to important discoveries. For the sake of convenience, I will commence with the most eastern locality, and take up the different nearly parallel beds in succession, up to the Tennessee line.

One mile east of Gaston, near the Roanoke River, there occurs a granular variety of hematite, more or less mixed with red and yellow ochre. The ore is apparently of very fine quality, but nothing is known as to whether it exists in quantities or not; if found in abundance, its location would make it valuable.

A large deposit of brown hematite occurs in the slate formation connected with quartzites, four miles west of Smithfield, Johnson County, and a bluff of limonite is exposed at Whitacker's, seven or eight miles south-west of Raleigh, in argillaceous and chloritic slates.

The various iron ore deposits of Chatham and Moore Counties are of much greater importance.

At Buckhorn, on the Cape Fear River, a large bed of granular magnetite has been developed, from which, if I am correctly informed, about 6000 tons of very superior iron have been produced. The bed is between 20 and 30 feet thick, and lies almost horizontally between micaschist. This magnetite is associated and largely intermixed with manganesian garnet, which serves as a flux, and renders it very easy to smelt. The iron was used during the war for car-wheels, and was of such excellent quality that one of the wheels, coming accidentally into the possession of a firm in Wilmington, Del., induced them to purchase the property, with a view to establish similar works in North Carolina. The beds dip slightly to the south-east, and appear to extend in this direction, and also to the south side of Cape Fear River.

A number of beds of hematite or specular iron make their appearance in Chatham County, in the argillaceo-talcose slates; the ores are the compact and granular hematite, of reddish, greyish and iron-black color, sometimes laminated, foliated and micaceous.

In Moore County, 12 miles east of Carthage, near Governor's Creek, there occurs a pure massive kidney-shaped hematite, without admixture, probably the south-west continuation of one of the Chatham ore beds.

On Ore Hill, in Chatham County, not only red hematites are found, but also large beds of brown hematite or limonite. This hill is between 200 and 300 feet high, and perhaps two or more large veins of about 10 to 15 feet in thickness, intersect the hill in an E. and W. direction.

The limonites are of fine quality, but their appearance and geological position would indicate that they are merely "gossans," or decomposed pyritous ores, and the probability is that at a greater depth the unaltered sulphides will be found. Since my return from North Carolina, the Ore Hill has been sold for $150,000, and there is a prospect that the old furnace on the place will soon be rebuilt and be put into blast.

The Evans ore bed is from six to eight feet wide, and has been traced for nearly one mile; it is about four or five miles from the Gulf, and consists of red hematite, of fine quality. Kelley's ore bed and several others show the same character.

The ores which I have seen are excellent, but none of them are worked.

Beds of granular magnetic iron, of fine quality, have also been found not far distant, but none of them are developed. One, for instance, is about 2 — 3 miles north of Evans ore bed.

I cannot leave Chatham County without mentioning the peculiar ores which, many years ago, have been much speculated upon as being of immense value, I mean the so-called *Black Band* ores interstratified with the coal. There are three seams of this black band between the coal beds. One of these seams is six feet in thickness, and consists of argillaceous carbonate of iron in balls and layers.

Unfortunately, only a very small quantity of this ball ore could be selected which would be pure enough for the manufacture of iron. The *great mass* contains such an abundance of bones and teeth of saurians and fishes, that the amount of phosphoric acid in the same renders it absolutely worthless as an iron ore; the quantity of phosphoric acid is so great, that it has been proposed to apply it to the soil as a manure.

A band af red hematite, probably the continuation of one of the Chatham County beds, passes through Orange County. It is quite prominent on a hill about 1½ mile north-west of Chapel Hill. The surface is covered with ore, some of it almost pure sesquioxide of iron. Like Pilot Knob, in Missouri, it forms a series of quartzose bands, frequently with bands of pure ore alternating with quartz more or less mixed with ore.

North-east from it, in the same County, at Red Mountain, extensive beds of this ore have been discovered.

In Montgomery, Randolph and Alamance Counties, several iron ore beds have been found, which at a future day may become of importance.

Six or seven miles south-west of Troy, a band of hematite lies between bands of auriferous slates, bordered on one side by quartzite, on the other by slaty pyrophillite. It forms a mass of about 50′ wide, which has been traced for quarter of a mile. The bed is traversed by massive hornblende.

About four miles north of Troy a series of magnetic iron ore beds occur in the neighborhood of Carter's Gold Mines. The ore is frequently crystallized, friable, and is intermixed with talc and quartz. The continuation of some of these ore beds pass through Randolph and Alamance Counties, where they yield ores of most excellent quality, as, for instance, three or four miles south-west of Franklinville, where an abundance of fine magnetite is found on the surface in the immediate proximity of a vein, and at La Grange; at the latter place there also exist large deposits of bog iron ore.

Some of the most important developments have been made within the last two years by the North Carolina Centre Iron and Manufacturing Company, of this city, not only in the great titaniferous iron belt which passes principally through Guilford and Rockingham Counties, and extends through the edges of Forsythe and Davidson Counties, but also in numerous outcrops forming parallel ranges with this formation.

I have already mentioned the accumulation of iron ore in the gneissoid rocks of the Greensboro' Belt.

The ore forms one or more strata between the rocks, and their extent has been proved for about 30 miles. Near the north-eastern extension the ore beds present a remarkable character, as proved by Prof. J. P. Lesley. He has shown the beds to be outcrops of the same synclinal basin, the so-called Tuscarora range being the south-east outcrop, with a north-west dip, while the so-called Shaw range is the north-west outcrop, with a south-east dip. The ore is a granular magnetite, more or less mixed with a micacceous mineral, also with hematite or menaccanite, and in some places it is associated with granular corundum or emery.

The average yield of the ore is 55 per ct. of iron; it contains, as I have already mentioned, small quantities of chrome, cobalt and manganese, and on an average about 13 per ct. of titanic acid, equal to 8 per ct. of titanium.

This titanic acid is not chemically combined with all the ore; in some of the varieties I have succeeded in separating, by the magnet, ore which was almost free from it, leaving the not magnetic menaccanite behind.

During the war, it was worked in bloomeries on a small scale, about two miles from Friendship, Guilford County, on a place which is now called Tuscarora, and has produced a quality of iron which was very remarkable for its toughness, its great strength and adaptation for the manufacture of steel.

Almost in range with these ore beds, magnetites as well as titaniferous iron ores have been found at several places in Mecklenburg County: the first, eight or nine miles from Charlotte, of Steel Creek Church; also, about seven miles from the same town, on the York road; and the titaniferous ore near the old Harris mine, 12 miles south-east of Charlotte. It cannot at present be ascertained whether these ores are connected with those of Guilford County.

Before I proceed with the consideration of the numerous iron ore beds of the slates of the Kings' Mountain group, I will mention that north-west of the titaniferous iron ore ranges of Rockingham, Guilford, etc., Counties, at least three ranges have lately been found between it and the Dan River, called the Johnny Watson, Love and McQuillan ranges. No developments have been made as yet, but the analyses of some of the ores show them to be free from titanic acid, and yielding about 50 per ct. of iron.

A very extensive and important belt of iron ores, which has furnished the greater portion of the iron used in the State, occurs in the slates of the King's Mountain group. It consists of a series of parallel magnetite ore beds extending, with frequent interruptions, from the neighborhood of Danbury in Stokes County, across the entire State into South Carolina.

The character of this series of magnetite beds is so uniform that it would be tedious to enumerate all the important beds; I will therefore point out only a few of the most characteristic ones.

The ores are granular magnetites *without titanic acid*, at times quite pure, but generally in part altered into hematite, and more or less intermixed with fine grained actinolite, tremolite, talc or chlorite and frequently associated with small quantities of epidote. The average of the ore is above 60 per cent.

A very fine bed of this granular magnetite associated with actinolite is the Rogers ore bank, near Danbury in Stokes County, which has been worked for a long time, and the ore smelted at the furnace on the Dan river.

There are several parallel ore beds; the upper is of the finest quality and most valuable. It is between seven and twenty feet in width, yielding on an average about 60 per cent. of iron. The ore is almost free from phosphorus and sulphur. Some of the smaller beds at their outcrop are rather sulphurous. Similar very fine beds occur in Surry County; the ores are schistose granular magnetites, with talcose, micaceous and quartzose admixtures.

At Tom's Creek this ore has been worked since 1795, and bloomeries are now in operation. Other ore beds, which also have been extensively worked, are the Williams' Ore Bed and the Hyatt's Mine.

The southern continuation of the ore beds of Stokes and Surry are developed again in Forsythe and Yadkin Counties. The character of the granular magnetites remains the same, and is an association of talc or actinolite. They have been extensively worked at Hobson's in Yadkin County, near the east bend of the Yadkin River and other places.

Probably the beds in Davie County, on the South Yadkin River, are the same, and pass through Iredell County near Statesville into Catawba and Lincoln Counties, where they have again been extensively worked for a long time in blast furnaces, as well as in bloomeries, producing iron of great strength and toughness.

In Gaston County the same beds of granular magnetite, to a great extent altered into hematite, with a fine grained actinolite slate, have been worked on the High Shoal property on the Little Catawba River, at Ellison's and Carson's Ore Banks.

Not only magnetites furnish the material for the production of iron, but also very fine limonites, fibrous, cavernous and partly resulting from the alteration of carbonate of iron, often yet showing its crystalline structure. They occur in large veins or beds in the slates; as they result mostly from the oxidation of pyritous ores, it may be expected that at a greater depth this will replace them entirely. The Orman and Mine Mountain and Ferguson Ore Banks, all on the High Shoal property, have been extensively worked. It is to be regretted that litigations have thus far prevented Admiral Wilkes from commencing operations at this highly valuable property, with its magnificent water power and other facilities for conducting a large manufacturing business. Near the top of Crowder's Mountain a vein of specular iron has been found. In the vicinity of King's Mountain the magnetic ores have been worked since the latter part of the eighteenth century. One of the ore beds is about forty feet thick. Besides the magnetites there are also limonites of good quality. A very striking feature of this very important and extensive belt of magnetites is its proximity to a parallel band of limestone, which accompanies the iron ore at almost every locality from Danbury down to King's Mountain.

Entering again the gneissoid rocks, we meet near Newton in Catawba County a very valuable bed of granular magnetic iron in syenite, resembling the ore from Cranberry in Mitchell County.

Magnetites as well as hematites are found in Wilkes and Caldwell Counties, some of which were formerly manufactured into iron. One very promising outcrop of large beds of fine granular *titaniferous* magnetite, for instance, has been observed near the Yadkin River, one mile west of Patterson, and another two miles north of Hickory, both in Caldwell County. At the latter place there also occurs red hematites and limonites in large deposits and of excellent quality. It is probable that further developments may prove the existence of a more extensive range, since similar granular magnetites have been found near Morgantown, almost in a line with the strike with the more northern beds.

Another bed accompanies the limestone of McDowell county on both sides of the North Fork of the Catawba River; the ores are limonite sometimes also hematite mixed with magnetite. These limonite beds continue to the west of the Blue Ridge, where we find them again overlying the limestone in Henderson and Transylvania Counties.

Several beds of limonite and occasionally hematite of good quality, exist in several localities of Buncombe county, so at Ore Mountain, two miles south west of Swannanoa Gap, and also 4—5 miles west of Ashville.

The magnetites and hematites west of the Blue Ridge deserve the highest attention, as they are not only of very superior quality, but also found in inexhaustible quantities. The most northern bed of magnetites is found in Ashe County at the North Fork of New River, near Hilton Creek. The ore is granular and talcose, in its general character almost identical with the ores of the King's Mountain range, being granular magnetites of somewhat slaty structure from the intermixture of small quantities of talc. The ores have been worked in bloomeries and have yielded a good quality of iron.

A very superior ore occurs at Cook's Gap in Watauga County. It consists of an almost pure stratified red hematite with octahedral crystals of magnetite disseminated through the mass. It is associated with limonite. It is an ore worthy of fuller investigation.

A number of iron ore beds are found in Mitchell County; the most valuable deposits are about one and a half miles south of Cranberry, near the Tennessee line. The ore beds have not been sufficiently explored to show their geological character and size, but they appear to be inclosed between hornblende slates and a peculiar micaceous slate.

The size of the ore beds must be enormous; judging from the outcrops it may have a width of 300—400 yards, and extends for more than half a mile; the whole side of the hill is covered with large blocks of the finest quality of magnetite, which evidently exists there in inexhaustible quantities.

The magnetite is often quite pure and polaric, coarse-grained, sometimes crystallized in octahedra, and associated with pyroxene and epidote. The pyroxene weathers into a brown ferruginous clay, in which are inclosed grains of magnetite. As these ores are soft and require little labor, they are the *only* ones worked and converted into blooms, at the works about two miles distant. The whole production is not over one ton of blooms a day. The finest quality is not touched. The analysis of a specimen representing about the average character of the ore, showed it to be entirely free from sulphur and phosphorus, and containing ·65 per cent. of iron.

There are several promising outcrops of magnetic ore beds in Mitchell County, but most of the other ores are menaccanite, which occurs at the following localities: at Crab Orchard, Cane Creek and Flat Rock.

In Madison County, on the east Fork of the Big Laurel, a large ourcrop of slaty fine grained granular magnetites, of apparently very good quality occurs, also a highly titaniferous menaccanite, containing nearly 38 per cent. of titantic acid. A bed of specular iron exists at Jewell Hill.

Other beds of magnetic ores in the same county occur in hornblende slates near Fines Creek in Haywood, and in garnetiferous micaschist at several points in Macon County.

I have yet to mention the immense beds of limonite or brown hematite, which occur in several localities in Cherokee County, associated with the limestone or marble and talc, one of which is worked, about one mile from Murphy.

The ore is of very fine quality, compact, also porous and fibrous, in some places ochreous; the quantity is inexhaustible, and beyond doubt the region where these deposits exists will sooner or later become a large iron manufacturing district.

Coal. The great abundance of iron ores in North Carolina requires for their reduction a large amount of fuel, and the question of its supply has for a time given a great deal of anxiety to those who are most largely interested in the manufacture of iron, as under the present system of forest destruction, instead of cultivation, the manufacture of charcoal iron must eventually be abandoned, although this may not take place for hundreds of years yet to come. It is therefore of the greatest importance that North Carolina contains several kinds of coal, some of which are of excellent quality, and in the immediate neighborhood or within a short distance only of the most valuable iron ore deposits.

I have already stated that the North Carolina coal does not belong to the so-called carboniferous period, but to the triassic; it is of the same age as the coal near Richmond, Va.

In Chatham and Moore Counties is the south-eastern extension, generally called the Deep River Coal Field; in Rockingham and Stokes Counties the north-western of the same beds, or the Dan River Coal Field. The centre is washed away.

From the investigations of Prof. Emmons and Admiral Wilkes, we learn that the Deep River coal is of the best quality, well adapted for the manufacture of iron and gas, and can be obtained in inexhaustible quantities.

The area underlaid by coal is over forty square miles, containing over 6,000,000 tons of coal to each square mile. The coal measures consist of strata of slates, calcareous shales, alternating with beds of argillaceous carbonate of iron and seams of coal, all inclosed between two beds of red sandstone.

Five seams of coal have been observed; the upper consists of a bed of six and a half feet in thickness, separated by a seam of black band. Near the outcrop it is somewhat contaminated with sulphur, which diminishes, however, as the depth increases. There are several varieties of coal, the highly bituminous and semi-bituminous;

near a trapdyke it has lost almost the whole of its volatile matter and has become an anthracite. According to an analysis of coal from the deep pit at Egypt, by Dr. Jackson, it contains:

Fixed Carbon = 63·6
Vol. Matter = 34·8
Ash = 1·0

An analysis of Egypt coal, which I have lately made, gave:

Moisture = 0·84
Vol. Matter = 25·75
Fixed Carbon = 63·27
Ash = 10·14
100.00 per cent.

It contained 1·35 per cent. of sulphur.

An analysis of coal from the Gulf gave me:

Moisture = 1·16
Vol. Matter = 21·90
Fixed Carbon = 70·48
Ash = 6·46
100.00 per cent.

Sulphur only 1·02 per cent.

All these analyses show the great value of the Deep River coal.

The Dan River coal field embraces an area of over thirty square miles; it has hardly been developed. Small quantities have been mined near Madison, Rockingham County, which were used by the blacksmith in the neighborhood; and the North Carolina Centre Iron and Manufacturing Co., of this city, has made a few trial pits which have proved the existence of five beds of coal, although it is probable that there are others besides.

The coals which I have examined from two of the seams near the outcrop gave respectively, 11·44—13·56 per cent of ash, 75·96 and 76·56 per cent. of fixed carbon and about 12 per cent. of volatile matter. These results are very encouraging. The Dan River coal field being the north-west continuation of the Deep River, has probably the same seams, and, where the coal is undisturbed, the same quality of coal. These coal fields are not only of general value, but, when it is remembered that they lie in close proximity to some of the largest and best iron beds in the State, their importance can then be fully appreciated.

Diamond and Graphite. North Carolina possesses carbon, not only in the form of several varieties of coal, but also in its two other modifications, as diamond and graphite.

Both occur in the old gneissoid rocks, the graphite in beds interstratified with the micaschist or gneiss; the diamond in the débris of such rocks, associated with gold, zircon, garnet, monazite and other minerals.

It is very remarkable that these two minerals are found in strata of the same age; and this fact reminds me of an analogous one, which may throw some light on their origin, viz., in producing the adamantine boron we always obtain the graphitic form at the same time.

Diamond has not been observed in North Carolina in any more recent strata, and in the itacolumite regions *no* diamonds have ever been found, as in Brazil; from which it appears that the itacolumite of Brazil is either simply a quartzose micaslate of similar age with the North Carolina gneissoid rocks, or that, if it is cotemporary with the North Carolina itacolumite, the diamonds were not *produced* in the same but came from older rocks, and were re-deposited with the sands resulting from their reduction to powder and are now found imbedded in the same, their hardness having preventing their destruction. Seven or eight diamonds have thus far been found. They occur distributed over a wide area of surface in the counties of Burke, Rutherford, Lincoln, Mecklenburg and Franklin, and I have no doubt, if a regular search would be made for them, they would be found more frequently. Some of the stones were fine crystals of first water; their weight was from one half karat to about two karats.

Graphite, so much in demand now for the manufacture of crucibles for melting steel and other metals, for lead pencils, as an anti-friction agent, for stove blacking, paint, &c., is found in numerous localities in the State.

The largest beds known since nearly half a century occur a few miles west of Raleigh in Wake County. There appear to be two belts about half a mile apart; the beds contain several seams of greater purity from six to eighteen inches in width. The beds are known to extend for a distance of eighteen or twenty miles.

It has been explored seven miles north-west of Raleigh, and a shaft has been sunk to a depth of one hundred feet. It is mostly mixed with fine grit and is rather slaty, and would require mechanical means for the separation of the impurities. Other beds of graphite, but not so extensive, are found in Lincoln, Caldwell, near Hickory, and in Burke Counties near Morgantown. None of them are developed.

The best quality which I have seen came from Alexander County, three miles from Taylor's, and from Cane Creek in Person County.

Sulphur is not found in North Carolina, except occasionally in small crystals, in cavities of quartz, resulting from the decomposition of pyrite. A large supply of sulphur ores will be furnished when the mines of the State are worked to a greater depth. One large vein of pure iron pyrites occurs in Gaston County. Most of the other veins will furnish in addition gold and copper.

Corundum.—Corundum, which, on account of its hardness, is so much sought for as a cutting and polishing material for hard substances, has been found, in a state of great purity and abundance, at several places in the neighborhood of Franklin, in Macon County, in connection with granites and chrysolite rocks.

It is mostly greyish or brownish, but sometimes it assumes a beautiful sapphire blue and ruby color. It is to be regretted that the blue has not yet been found in pieces large enough to be cut for gems, and that the ruby has not the requisite trasparency. A large boulder of dark blue corundum was found, many years ago, near the French Broad River, in Madison County. It has lately been observed on the Burnsville Road, 19 miles from Ashville. In small quantities it is found at Crowder's and Clubb Mountains, Gaston County.

The granular corundrum or emery is associated with the magnetites of the great titaniferous iron range in Guilford County.

Rutile.—Titanic acid, in the form of rutile, used in the arts to give a peculiar color to artificial teeth, is found in considerable quantity at Crowder's and Clubb Mountains, in Gaston County; also at several localities in Mecklenburg and Mitchell Counties.

Mica, Feldspar, Kaoline, Pyrophyllite.—Hundreds of years ago, long before the Indians occupied the territory of North Carolina, many excavations were made in the numerous large coarse-grained granite beds of Mitchell, Yancey, Cleveland and other Counties. In the year 1867 a number of these old mines have been taken up again, and now mining, on a somewhat extensive scale, is going on, and a great portion of the mica used in the arts for stoves, lamp-shades, window-panes, etc., comes from Mitchell and Yancey Counties, North Carolina. The mica has mostly a slightly brownish color; it occurs, irregularly distributed, through the granite, in rounded pieces, some of them weighing several hundred pounds. It is then split and cut into marketable shapes, which, according to size, will sell from $1 — $10 per pound.

The same localities furnish a very fine quality of orthoclase or potash feldspar, used for glazing porcelain and for artificial teeth.

At some of the mines in Mitchell County the orthoclase is almost completely decomposed, and leaves frequently a snow-white kaoline or porcelain clay. It is found at several other localities. as in Lincoln, Burke and Macon Counties.

In the region of the Deep River, in Chatham and Moore Counties, very extensive beds of pyrophyllite slate have been worked for a long time.

It is sometimes called agalmatolite, from the fact that from a dense variety of the same rock the Chinese cut and carve their little images, idols and toys. The North Carolina mineral, being entirely free from grit, is largely used as an antifriction material, also for the lining of furnaces, slate-pencils, in the manufacture of wall-paper, as a cosmetic, and for other purposes. Other, though less extensive, beds have been found in Montgomery and Gaston Counties.

Serpentine, Talc.—Only one locality has come to my notice from where a serpentine could be obtained fit for ornamental purposes. It has a dark greenish-black color, contains very small seams of a greenish chrysolite, with silky lustre, and acquires a good polish. Found in large quantities 1½ mile below Patterson, in Caldwell County.

The serpentine found in the chrysolite beds west of the Blue Ridge are of no value.

The most beautiful white, or greenish-white massive, or finely crystallized talc is found, in inexhaustible beds, in many places in Cherokee County.

It is used for similar purposes as the slaty pyrophyllite of Chatham and Moore Counties. Massive and schistose talc, or soapstone, suitable for fire-places, mantle-pieces, stove-linings, etc., is found in many localities in the State.

Barytes.—This material, when quite white much used as a paint, and more generally for the adulteration of "*white lead*," is found in abundance and excellent quality at several localities. A coarsely granular variety, white, like marble, is found in Union County; another similar one, massive and granular, in a vein from 7 to 8 feet in thickness, in Gaston County, at Crowder's Mountain; and a greyish-white laminated variety, at the Latta mine, near Hillsboro', in

Orange County. West of the Blue Ridge it is found, in white granular masses, at Chandlers', nine miles below Marshall, in Madison County.

Alum and Copperas.—Many of the gneissoid slates of Cleveland, Rutherford and other Counties contain large quantities of pyrite finely disseminated through them, which, by oxidation, or weathering, produces copperas and alum, both of which were therefrom manufactured on a large scale during the war.

Marble.—Only in one or two localities in the limestones of Stokes and Catawba Counties, a fine-grained variety is found, which would be useful for ornamental purposes if the quantities were not too limited. West of the Blue Ridge, however, in Cherokee and Macon Counties, it is found in large beds, of the finest qualities. There is not only the fine-grained white, resembling that of Carrara, but also the greyish-veined marble, like the Italian, and a most beautiful variety of a fine pink hue.

The limits of this paper are already far beyond my original expectations; and still I might add many more details which would be of interest. In as concise a form as possible, I have indicated and described the principal valuable minerals in the State, and the localities where they occur. I have dwelt rather more fully upon gold, copper, iron and coal, because of their greater importance, especially the two latter, which I believe will prove a source of immense wealth to the State.

My various visits to North Carolina, and more particularly the opportunities afforded me for observations during my trip there last summer, have enabled me to collect many facts and much data relative to the various mines and mining districts, which doubtless would be of interest, but which want of space compels me to omit for the present. I hope, however, that at some future day it will again be my privilege to present the Franklin Institute with further observations on this interesting subject.

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